(*d*) Greater possible mileage per train per day, increasing the earning capacity of any given quantity of rolling stock, and increasing the loading and unloading capacity of existing platforms.

The Southport branch of the Lancashire and Yorkshire Railway has proved to be a commercial success under electric working. It consists of a coast line of 18½ miles, having fifteen stations. The total length of electrified line in the district amounts to four miles of four tracks and twenty-five miles of double tracks, making a total of seventy miles of single track, including sidings. It has been found possible to run all the passenger traffic on the double track on the section having four tracks, leaving the other double track free for goods traffic, thus enabling several stations on the goods track to be closed. The line is considered to provide the fastest service of this character in existence. Stopping trains run 18½ miles, stop fourteen times, and do the journey in thirty-seven minutes. Express trains run the same distance in twenty-five minutes.

During the transition stage from steam to electrical working there came a period when it was necessary to run steam trains in between the electrical trains at the same speed in order to keep them out of the way of the latter. An opportunity was thus afforded of comparing the coal consumption of the locomotives and the power house, and it was found that the six-wheeled coupled tank engines which did the work in 1904 consumed 80 lb. of coal per train mile with express trains, and 100 lb. with stopping trains. The consumption of coal at the power station in 1908 works out at 49 lb. per train mile for the electrical trains.

The time necessary for the conversion from steam haulage to electric traction is of importance. In the case of the line under discussion, the order for commencing the work of electrification was given on October 22, 1902, and the work was finished and the steam trains entirely withdrawn on May 13, 1904.

After considering the questions of the wear in third and fourth rails, Mr. Aspinall dealt with the important matter of the excessive wear of track rails in electrical working. In his opinion, the special rails introduced by Sandberg were not the real cure. The real fault is one of construction. The more or less modern motor truck has all the defects of the older-fashioned locomotives on account of the low position of the centre of gravity. The modern steam locomotive with a high centre of gravity is a very easy riding machine. A motor-car, with its four axles, has a total weight of 12 tons, which is not carried by the springs. Raising the centre of gravity so as to enable this weight to be spring-borne would introduce additional mechanism, and would also block up the passages from car to car. The great advantages of direct drive would be lost, and as the present gears run extremely well it may be a more commercial method to wear out the cheap rail instead of expensive mechanism.

The cars on the Southport line are 60 feet long, and have large side doors at each end. These doors are opened or closed by the public themselves, who, by a bye-law sanctioned by the Board of Trade, are required to enter the car by the rear door and leave by the front door. This system requires a smaller platform staff, but as the larger number of electric trains requires more guards, the total number of men employed remains the same. During the rush hours the cars are emptied in fifty seconds at terminal stations, while intermediate stops consume fifteen seconds only.

Mr. Aspinall favours overhead conductors wherever possible. In the particular case of the high-tension line connecting Aintree with Seaforth, the cost per mile of the overhead equipment was 1300*l*., while the cost per mile of the cable line was 2030*l*.

It was decided in 1905 to install battery plants; the general idea was to provide for running the whole railway for one hour in the event of any serious accident at the central generating station. The battery substations are placed at points intermediate to the rotary substations, and have had the effects of reducing the momentary peaks in the load from a maximum of 7000 kw. to 4500 kw., and the hourly peak during the rush hours from 3800 kw. to 3100 kw., enabling the load to be carried during the winter with 4500 kw. of plant, and during the summer with 3750 kw. of plant.

The total over-all efficiency was found in July, 1906, to be 81 per cent. from the alternating current bus bars to the circuit breakers on the trains. The coal burned at the power house per unit of direct current delivered to the third rail, including all conversion losses, amounted to 3·28 lb. for the twelve months ending December 15, 1908.

In 1907 the Aintree line was electrified, and has led to the recovery of much of the traffic which had been taken away by the Municipal Tramways, which run parallel to the railway. On Grand National Day the race traffic on this section amounts to 13,000 people in about 2¾ hours.

Mr. Aspinall estimates that any railway company having facilities for putting its own plant down in the country, with opportunities of getting cheap coal and water, should be able to produce current at the generating stations at a "works cost" of 0·25 penny per B.T.U. A high-speed service could then be worked at a cost of 9·5*d*. per train mile. No amount for depreciation, other than battery depreciation, is included in this, or for interest on outlay. The figure does not include the maintenance of running track and stations, costs of platform staff, or other items common to both steam and electric lines. The great economy to be hoped for in the future for electrical railways, where no water power is available, is in the production of electricity in very large quantities; the total current-producing charges amount to the large proportion of 4·52*d*. out of the above-mentioned 9·5*d*. Other possible economies are in the direction of such improved design in the motors as will lead to less repairs and a very careful consideration of the whole design of the motor truck. Items which may be put down as giving no trouble whatever are controllers, commutators, steel spur-gearing, and the third rail.

Mr. Aspinall looks forward to the opportunity which he hopes to afford members of the institution during the summer meeting at Liverpool of seeing the Liverpool and Southport line at work. The proceedings terminated with a hearty vote of thanks to the president for his interesting and valuable address, moved by Sir Wm. White, K.C.B., and supported by Mr. W. H. Maw.

There are ten appendices, with curves and photographs, giving minute information regarding the working of this line of railway.

SOME RECENT PALÆONTOLOGICAL PAPERS.

THE description of the fossil flora of Tegelen-sur-Meuse, near Venloo, in Holland, by Clement Reid, F.R.S., and Eleanor M. Reid (*Verhandel. d. kon. Akad. van Wetenschappen te Amsterdam*, September, 1907), is remarkable as showing how skilfully devised methods of observation will reap a rich harvest from "a box of clay easily carried by a man." The specimens of seeds washed or floated out of this Pliocene clay were temporarily preserved in formalin or salicylic acid; they were then washed in water, and each was placed, still wet, on a film of paraffin wax on a glass slide. The plate was immediately warmed from below, and the paraffin rose to take the place of the water evaporated from the seed. The surface could be cleaned with benzine and the seed was now so tough that it could be easily handled. The Tegelen flora indicates a stage just earlier than that of the Cromer Forest bed.

An illustrated paper on historic fossil cycads, by G. R. Wieland (*American Journal of Science*, vol. xxv., 1908, p. 93), directs attention to new points in some of the great cycad stems and casts in the museums of Europe. The type *Cycadeoidea etrusca* in Bologna is a silicified stem that was used as a sharpening stone in an Etruscan city some 4000 years ago, and it is claimed as "the most anciently collected of all geological specimens."

From Japan come two papers on fossil plants (Journal of the College of Science, Tokyo, vol. xxiii., 1908, articles 8 and 9). In the former, M. Yokoyama describes spoils of war, in the form of Upper Carboniferous plants collected during the recent campaign in Manchuria. In the latter, H. Yabe, whose work on Fusulina has been previously noticed in NATURE, shows how the occurrence of *Giganto-*

pteris nicotiaenifolia in the Mungyong beds of Korea marks these strata as of Triassic age.

In the Proceedings of the United States National Museum, vol. xxxiv. (1908), p. 281, G. H. Girty describes an interesting series of sponges from the Carboniferous of Kansas, for which he is obliged to erect three new genera, Heterocœlia, Mæandrostia, and Cœlocladia. The specimens are now calcareous, and the first two were probably calcispongiæ, while Cœlocladia was a lithistid.

Mr. Girty goes on (p. 293) to describe several new Carboniferous brachiopods. The brachiopods of the Cambrian are added to by C. D. Walcott (Smithsonian Miscellaneous Collections, vol. liii., No. 1810, October, 1908). In a subsequent paper (*ibid.*, No. 1811) the same author gives a useful classification and terminology of the Cambrian Brachiopoda, in which attention is given to the structure of the shell and to the terms applied to its numerous details. A plate illustrates the microscopic structure.

Prof. A. P. Pavlow devotes a finely illustrated folio memoir to the relationships of the lamellibranch Aucella, with a review of all known species. An appendix deals with the Aucellinæ from the Russian Cretaceous strata (*Nouv. Mém. Soc. imp. des Nat. de Moscou*, tome xvii., 1907, p. 1).

Dr. L. Waagen, as an addition and a tribute to Bittner's work on the lamellibranchs of the Alpine Trias, has described "Die Lamellibranchiaten der Pachycardientuffe der Seiser Alm" (*Abhandl. d. k.k. geol. Reichsanstalt*, Bd. xviii., 1907, Heft 2, folio, price 30 kronen). Material gathered by Bittner before his death has been utilised and compared with a series of specimens in the collections of the University of Vienna. The memoir is no mere record of species, but contains philosophic criticisms of the position of several genera, such as Neumayr's Heminajas (p. 140), Sowerby's Myoconcha, and King's Pleurophorus (p. 154).

"Die Acanthicus-Schichten im Randgebirge der Wiener Bucht," by Franz Toula (*Abhandl. d. k.k. geol. Reichsanstalt*, Bd. xvi., Heft 2, 1907), forms yet another handsome folio, and is mainly devoted to ammonites. The author in 1905 found to his surprise, south-west of Vienna, a highly fossiliferous exposure of Upper Jurassic limestone. Quarrying operations allowed of the collection of a large amount of good material, including a new species, *Phylloceras giganteum*, measuring 44 cm. in diameter. Eight new species of Perisphinctes alone come from this limited locality. The author modestly explains that he has dealt with these fossils personally, since they came direct into his hands, and he felt a sort of devotion to them which it might have been hard to arouse in another worker. Nineteen exceptionally fine photographic plates place the features of the actual specimens before the critics whose comment is invited by the author.

An important stratigraphical and zonal paper, by N. T. Karakasch, on the Lower Cretaceous of the Crimea, appears in the *Travaux de la Société impériale des Naturalistes de St. Pétersbourg*, vol. xxxii., 1907. Numerous new species of cephalopods, among other fossils, are described and figured. Hoplites, it is noted, disappears in the Crimea before the Aptian epoch, though it occurs in higher series in other parts of Russia and in the Caucasus. The paper is accompanied by an abstract in French.

Dr. Kitchin's memoir on the invertebrate fauna and palæontological relations of the Uitenhage series (Ann. South African Museum, vol. vii., part ii., 1908) is also mainly concerned with molluscs. Bivalves are here prominent, but the ammonites furnish new species of Holcostephanus, which are shown among the beautiful figures drawn by Mr. T. A. Brock. The author strongly confirms the opinion, which has been gradually spreading, that these interesting beds in Cape Colony are of Lower Cretaceous and not of Jurassic age.

In "New Cretaceous and Tertiary Fossils from the Santa Cruz Mountains, California," by R. Arnold, of the U.S. Geological Survey (Proc. U.S. National Museum, vol. xxxiv., 1908, p. 345), a number of new molluscan species are figured from strata ranging from the Cretaceous to the Pliocene. Dr. Otto Wilckens issues a paper of faunistic importance on "Die Lamellibranchiaten, Gastropoden, &c., der oberen Kreide Südpatagoniens" (*Ber. d. naturforsch. Gesell. zu Freiburg-im-Breisgau*, Bd. xv., 1907, p. 97). The material collected by Prof. Hauthal and sent to Prof. Steinmann was not in a good state of preservation, owing to earth-pressures and weathering processes, but a great deal that is new among molluscan species has come to light. Dr. Paulcke follows (p. 167) with an account of the cephalopods from the same strata, including several new species of Hoplites. On p. 83 Dr. Wilckens, in a sketch of the geology of south Patagonia, places these fossiliferous beds as Upper Senonian.

Almost simultaneously, the seventh volume of the Anales *del Museo Nacional* appeared in Buenos Aires, consisting of H. von Ihering's memoir of 600 pages on "Les Mollusques fossiles du Tertiaire et du Crétacé supérieur de l'Argentine." Dr. von Ihering places himself in accord with Dr. Florentino Ameghino and against Dr. Wilckens on the question of the "Pan-Patagonian" system, which he consequently regards as Eocene. With some justice, he claims that the Tertiary beds of South America are to be judged by their own inter-relations, and not by the sequence in North America or Europe. He believes that a continental barrier, required also on zoological grounds, united southern Brazil and Africa in Eocene times. The characters of the Eocene fauna of Argentina are thus Antarctic and Indo-European rather than North American. The author, in determining his systems, relies on the principles of Lyell and Deshayes, laying great stress on the proportion of the molluscan species that are to be found in existing seas (pp. 95, 113, and 419). The Pan-Patagonian system is thus regarded as Eocene, the Entrerian as Miocene, and the gap between these as filled by the Magellanian or Oligocene. Ameghino, however, has placed the Entrerian as Oligocene. The pebble-beds that extend along the Patagonian coastlands from Tierra del Fuego to the Rio Negro are now known to contain molluscan bands, and Darwin's belief that they were marine is thus confirmed (p. 391). This "Araucanian" formation is classed as Pliocene. Von Ihering thinks that the lower part of the much-discussed Pampas system may be Pliocene, while the higher marine beds proclaim the upper part as Pleistocene. In southern Brazil and on the Buenos Aires coast there are still younger Pleistocene deposits, representing a considerable incursion of the sea (p. 431). The section of the memoir (p. 482) which traces the history of the successive marine faunas raises many questions that affect palæontology, zoological distribution, and general geology. On p. 545, for instance, examples are given of the influence of oceanic climate in sending the littoral species of temperate zones into deeper waters near the tropics, and in allowing of a "bipolar" distribution of other forms, since they can live at great depths over all the oceanic area intervening between the poles. The criticism of so extensive a memoir must be left to specialists, but it is clear that its conclusions will interest geologists of very different lines of study.

In the Proceedings of the Cotteswold Naturalists' Field Club, vol. xvi. (1908), p. 143, Mr. E. Talbot Paris describes echinoids from the Lias of Worcestershire, and, with Mr. L. Richardson (p. 151), writes on the stratigraphical and geographical distribution of the Inferior-Oolite echinoids of the west of England. The latter paper, while relying in part on Wright's work, makes useful additions to it, new species being introduced and figured.

Mr. A. W. Slocom describes several new crinoids, belonging to genera already known, from the Niagara Limestone of Chicago (Field Columbian Museum, Geol. Series, vol. ii., 1907, p. 273). Two new species of the aberrant genus Zophocrinus are included. Mr. R. Arnold, whose molluscan work is above referred to, describes a new species of the ophiurid Amphiura from the Upper Miocene of California (Proc. U.S. National Museum, vol. xxxiv., 1908, p. 403).

Mr. C. D. Walcott, having completed his work on brachiopods, promptly enters on an investigation of Cambrian trilobites (Smithsonian Miscell. Collections, vol. liii., 1908, p. 13). The present instalment describes the new genera Burlingia, Albertella, and Oryctocara. The first-named, from the Middle Cambrian, is placed with Moberg's Schmalenseeia in a special family, the Burlingidæ.

The Geological Survey of Great Britain issued in October, 1908, a welcome quarto memoir on "The Higher Crustacea of the Carboniferous Rocks of Scotland," by B. N. Peach, F.R.S. (price 4s.). Four new genera, one being appropriately styled Tealliocaris, and twenty-three new species, are described. The forms are all transferred from the macrurous decapods to the schizopods, following an opinion early formed by the author, and confirmed by Sars's report in the *Challenger* series in 1885. Palæocaris is interestingly placed in G. M. Thomson's Anaspidæ (p. 53), a family erected in 1894 to include a less specialised fresh-water form still living isolated in lakes among the mountains of Tasmania. The illustrations to the memoir show the excellent preservation of much of the material, and it is pleasant to learn that the work was undertaken by Dr. Peach on his retirement from the Survey directly he was free from pressing official duties.

Passing to vertebrates, Messrs. F. R. von Huene and R. S. Lull are engaged in a re-consideration of the affinities of Hallopus, a reptile described by Marsh from Wyoming, and now known to be of Upper Triassic age (Am. Journ. Science, vol. xxv., 1908, p. 113).

Mr. G. E. Pilgrim gives us a new genus of Suidæ, Telmatodon, from Lower Miocene beds in Baluchistan (Records Geol. Surv. India, vol. xxxvi., 1907, p. 45). Mr. F. B. Loomis shows how the rhinoceros Diceratherium was comparatively common in the Lower Miocene of North America in beds where few vertebrates were known until some three years ago ("Rhinocerotidæ of the Lower Miocene," Am. Journ. Sci., vol. xxvi., 1908, p. 51). Two species of Acerotherium, a genus abundant in the American Oligocene, lived on amid a rich variety of Diceratheria. By the close of the Miocene, the latter forms had also run their course.

Herr Wilhelm Freudenberg introduces the Pleistocene *Rhinoceros Mercki*, var. *Hundsheimensis*, Toula, in his account of the fauna of the Hundsheim cave in Lower Austria (*Jahrb. d. k.k. geol. Reichsanstalt*, Bd. lviii., 1908, p. 220). The animals of this cave, including Machairodus, which may have preyed on rhinoceroses and elephants, are held to have lived in the district at first under cold conditions, and then during a warm interglacial interval. The striped hyæna occurs (p. 212), a species that goes back far into the Pliocene. The absence of the horse and man also gives the deposit an early aspect.

G. A. J. C.

PAPERS ON MOLLUSCS AND INSECTS.

THE molluscs of the family Pyramidellidæ inhabiting the coasts of New England and the adjacent region form the subject of an illustrated monograph, by Mr. P. Bartsch, published in the Proceedings of the Boston Society of Natural History, vol. xxxiv., parts lxvii.–cxiii. Attention is chiefly concentrated on the characters of the shell, although mention is made of some of the soft parts in diagnosing the genera. The new genus Couthonella is proposed for the species hitherto known as *Pyramis striatula*.

To the proceedings of the Academy of Natural Sciences of Philadelphia for December, 1908, Prof. H. A. Pilsbry contributes the twelfth instalment of his account of the clausilias of the Japanese Empire, in which a number of new species and subspecies of various sections, or subgenera, of Clausilia are described and figured. Especial interest attaches to certain species belonging to the section Euphædusa, such as *Clausilia echo*, on account of their exhibiting stages in a degeneration-series leading on to the section Reinia. In the same issue Prof. Pilsbry and Mr. Y. Hirase describe a number of new land-molluscs from the Japanese Empire, including forms from the main island of Japan, the Benin Island, the Ryukyu (Liu-Kiu) Islands, and Formosa. Particular interest attaches to the clausilias and operculated shells from the small volcanic isles of the Tokara group.

The pteropods and heteropods of the Irish coasts form the subject of a paper, by Miss A. L. Massy, published as No. 2 of Irish Fisheries Scientific Investigations for 1907 (1909). The list includes seventeen species of pteropods, among which is a new species of Clio (*C. gracilis*) and seven other species not previously recorded from British waters. Heteropods, on the other hand, are represented, according to present information, in Irish waters only by a few occurrences of *Carinaria lamarcki*.

The habits of the British carnivorous slugs of the genus Testacella form the subject of an illustrated note by the editor in the April number of the *Selborne Magazine*. Special interest attaches to the figure of one of these slugs seizing a worm with its protruded "radula."

Turning to insects, we have first to notice the first three "leaflets" on injurious insects issued by the Indian Forest Department. Of these, No. 1 is devoted to the sal bark-boring beetle (*Sphaerotrypes siwalikiensis*); No. 2 treats of the moth known as the teak-defoliator (*Hyblaea puera*); and No. 3 describes the teak-leaf skeletoniser (*Pyrausta machaeralis*), which, in its adult condition, is also a moth. As two at least of these insects have been noticed in NATURE in connection with other publications of the Forest Department, it will suffice to add that the three leaflets have been drawn up by Mr. E. P. Stebbing. In vol. ii., No. 7, of the entomological series of the Memoirs of the Department of Agriculture in India, Mr. Maxwell-Lefroy discusses the scale-insects, or Coccidæ, of the country, the life-history of three species being illustrated by coloured plates. None of the Indian species of the group inflicts much harm on crops.

Brazilian grasshoppers of the subfamilies Pyrgomorphinæ and Locustinæ (or Acridinæ) form the subject of No. 1661 of the Proceedings of the U.S. National Museum (vol. xxxvi., pp. 109–163). Fifty-three species are discussed in this paper, among which the author, Mr. J. A. G. Rehn, describes seventeen as new, four new genera being also named and defined. The greater portion of the collection came from Matto Grosso and Rio de Janeiro, and the remainder from the neighbourhood of Pernambuco and Bahia. In the February issue of the Proceedings of the Academy of Sciences of Philadelphia, Messrs. Rehn and Hebard continue their survey of the Orthoptera of the south-western United States, dealing in this instance with those of New Mexico and Texas.

On a previous occasion reference was made in our columns to a paper in the Proceedings of the Philadelphia Academy of Sciences, by Dr. F. Creighton Wellman and Mr. W. Horn, on the tiger-beetles of Angola. In the same serial for December, 1908, the first-named author gives an account of Angolan oil-beetles (Meloidæ), in which special attention is directed to interesting features connected with the habits of these insects. Throughout the driest district of Angola various species of these beetles may be seen in thousands on a roseaceous plant of the genus Tribulus, which occurs in enormous masses, and forms almost the sole food-supply of the adult Meloidæ of the district. This plant produces large masses of yellow flowers, upon which the beetles cluster. It is remarked as a curious fact that the young of these oil-beetles should feed on the eggs, and later on the larvæ, of orthopterous and other insects, while the adults have such an intimate relation to certain plants, the appearance of the full-grown Meloidæ being synchronous with the flowering of the Tribulus, which lasts only for a few weeks.

An important contribution to morphology is formed by a paper on the so-called sclerites of insects, by Dr. G. C. Crampton, published in the Proceedings of the Academy of Sciences of Philadelphia for January. According to the author, there exists a most confusing want of uniformity in regard to the homology of these small chitinous elements and the names applied to them, this being, apparently, in great degree due to the fact that each investigator has been content to confine his studies to one or two groups of insects. Many important points have been brought to light by such investigations on the different orders, but they stand, for the most part, as isolated facts. The object of the investigations undertaken by the author has been to bring these isolated facts into harmony, and to construct a nomenclature for these structures which shall be applicable to the Hexapoda as a whole. With this object in view, Dr. Crampton first reviews the various theories of his predecessors on this subject, and then furnishes a revised and general system of nomenclature. A further communication on the subject is promised.

Publications by the Entomological Bureau of the U.S.